Atmospheric Fundamentals

- Atmospheric Variables
- Vectors
- Pressure
- Temperature & Moisture
- Fundamental Concepts

Scientific Measurements

Fundamental Quantities :

Mass (M)	Amount of matter in an object.
Length (L)	A measurement of distance.
Time (T)	A period over which an action takes place

Fundamental Units :

Mass (M)	Kilograms (kg)
Length (L)	Meters (m)
Time (T)	Second (s)

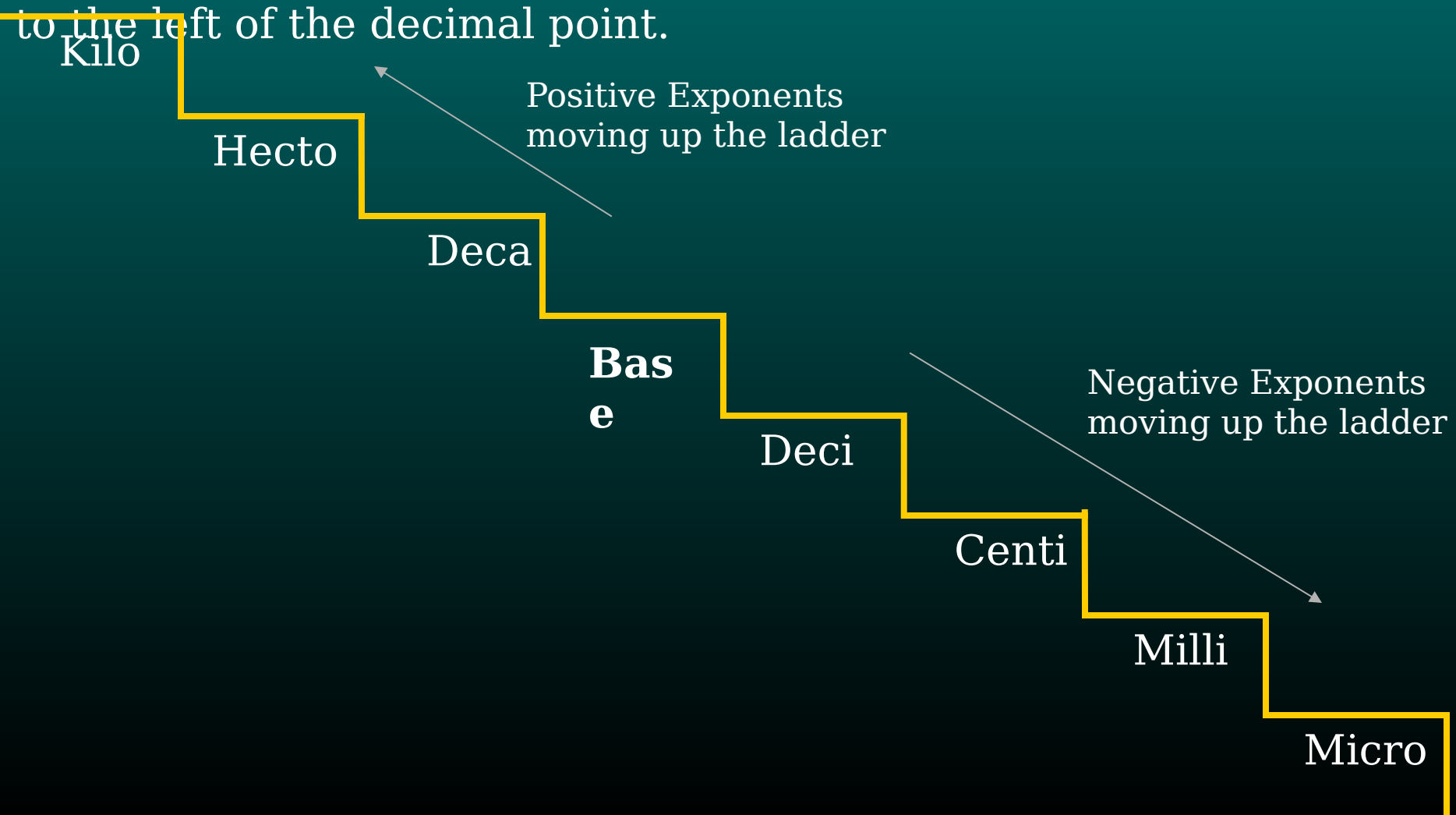
Scientific Measurements

Scientific Notation:

Prefix	# of Base Units	Scientific Notation
Kilo (k)	1,000	(10^3)
Hecto (h)	100	(10^2)
Deca (da)	10	(10^1)
Base	1	(10^0)
Deci (d)	1/10	(10^{-1})
Centi (c)	1/100	(10^{-2})
Milli (m)	1/1,000	(10^{-3})
Micro (μ)	1/1,000,000	($10^{-}6$)

Scientific Measurements

Scientific Notation : Move your Decimal point to the left or right until you get a single digit (1-9) to the left of the decimal point.

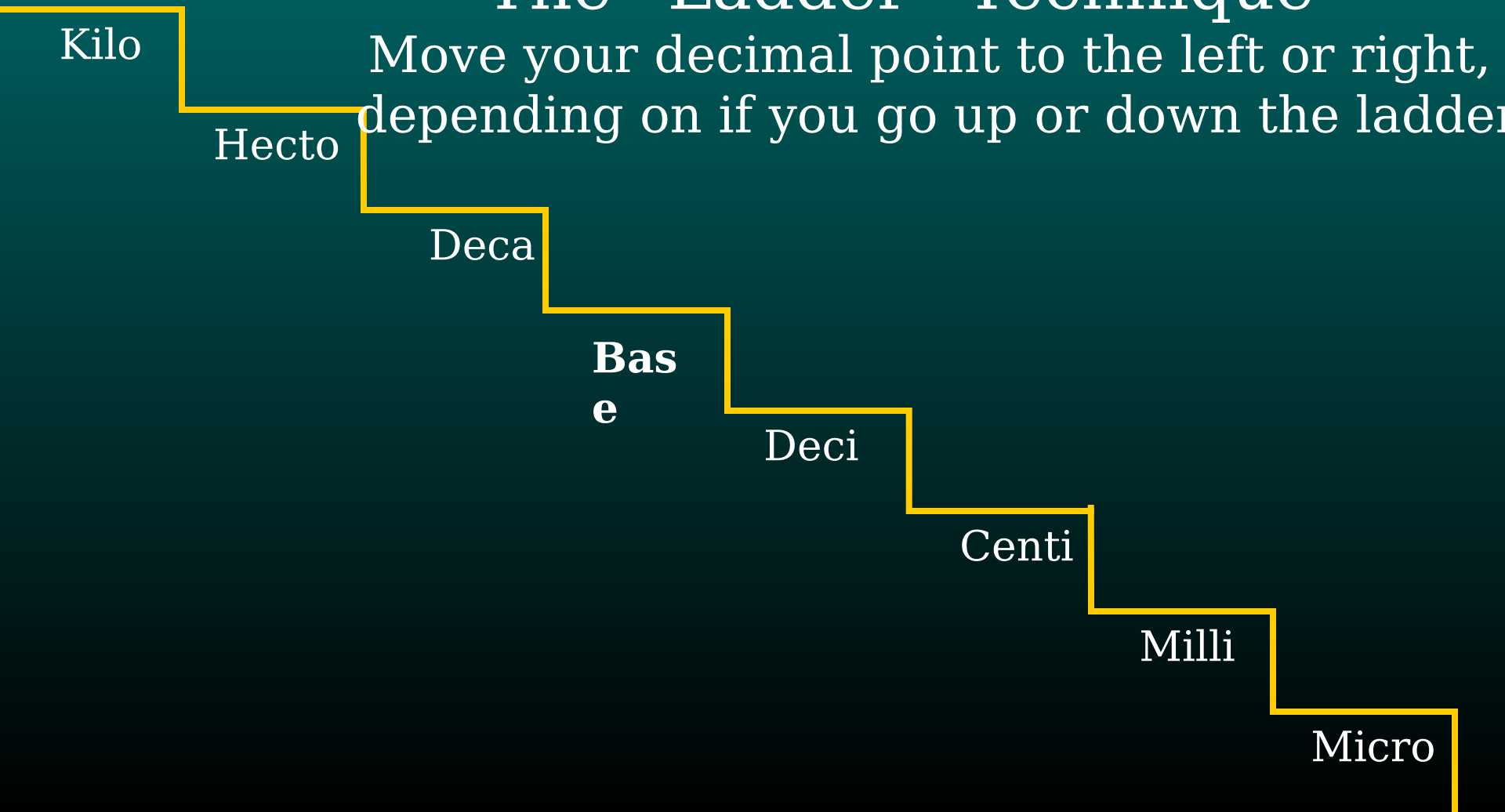


Scientific Measurements

Unit Conversions:

The “Ladder” Technique –

Move your decimal point to the left or right, depending on if you go up or down the ladder



Scientific Measurements

Significant Digits:

Nearest reportable values for common measureme

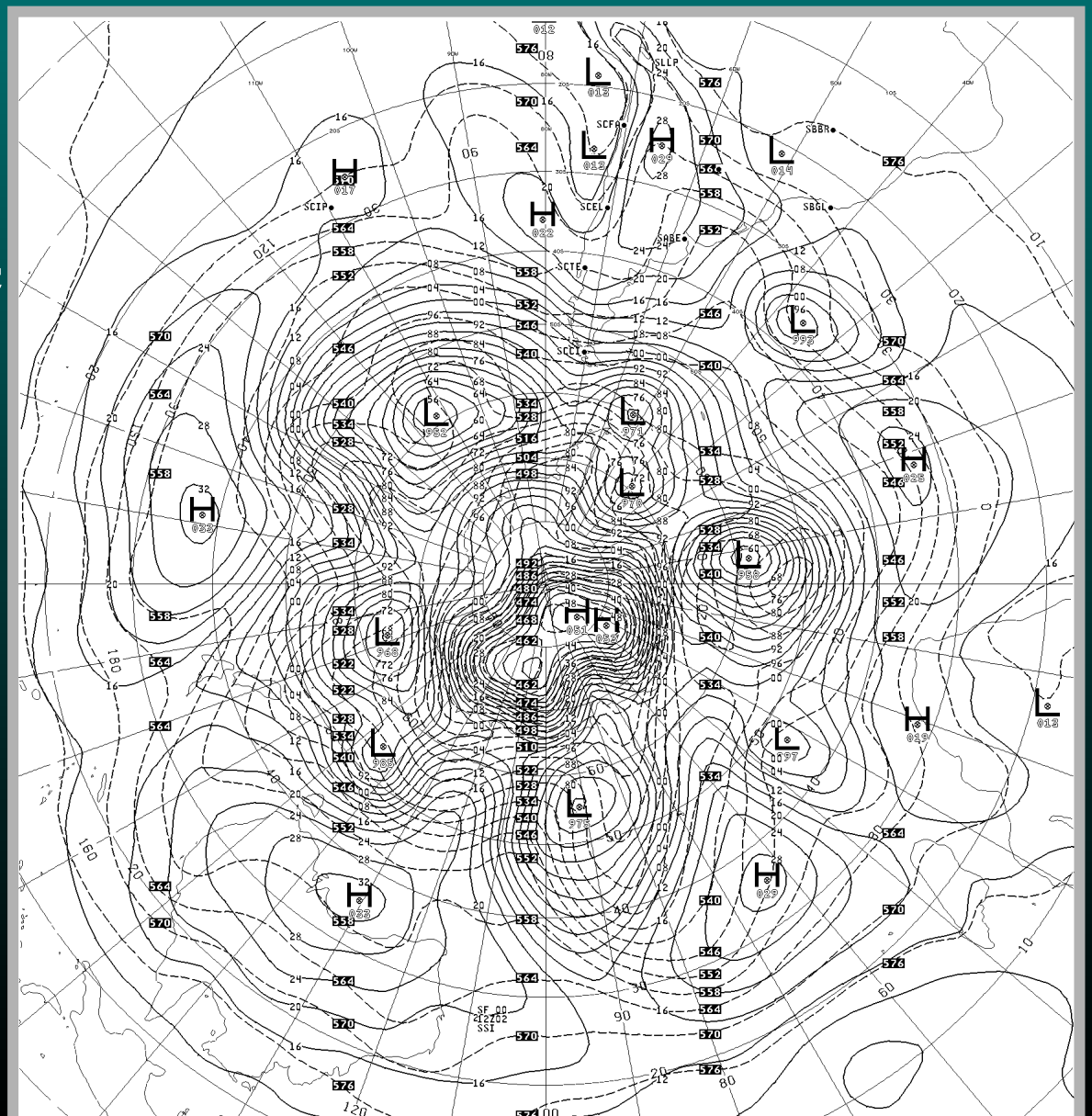
Upper Air Wind Speeds: 5 Knots
Surface Wind Speeds: Whole Knot
Upper Air Pressure: Whole Millibar (mb)
Surface Pressure: 1/10 (.1) mb
Skew-T Temperatures: 1/10 (.1) Degree
Temperatures: Whole Degree
Relative Humidity: Whole Percent
Upper Air Heights: Decameter

Atmospheric Scales

Macroscale:

- Jet Axis

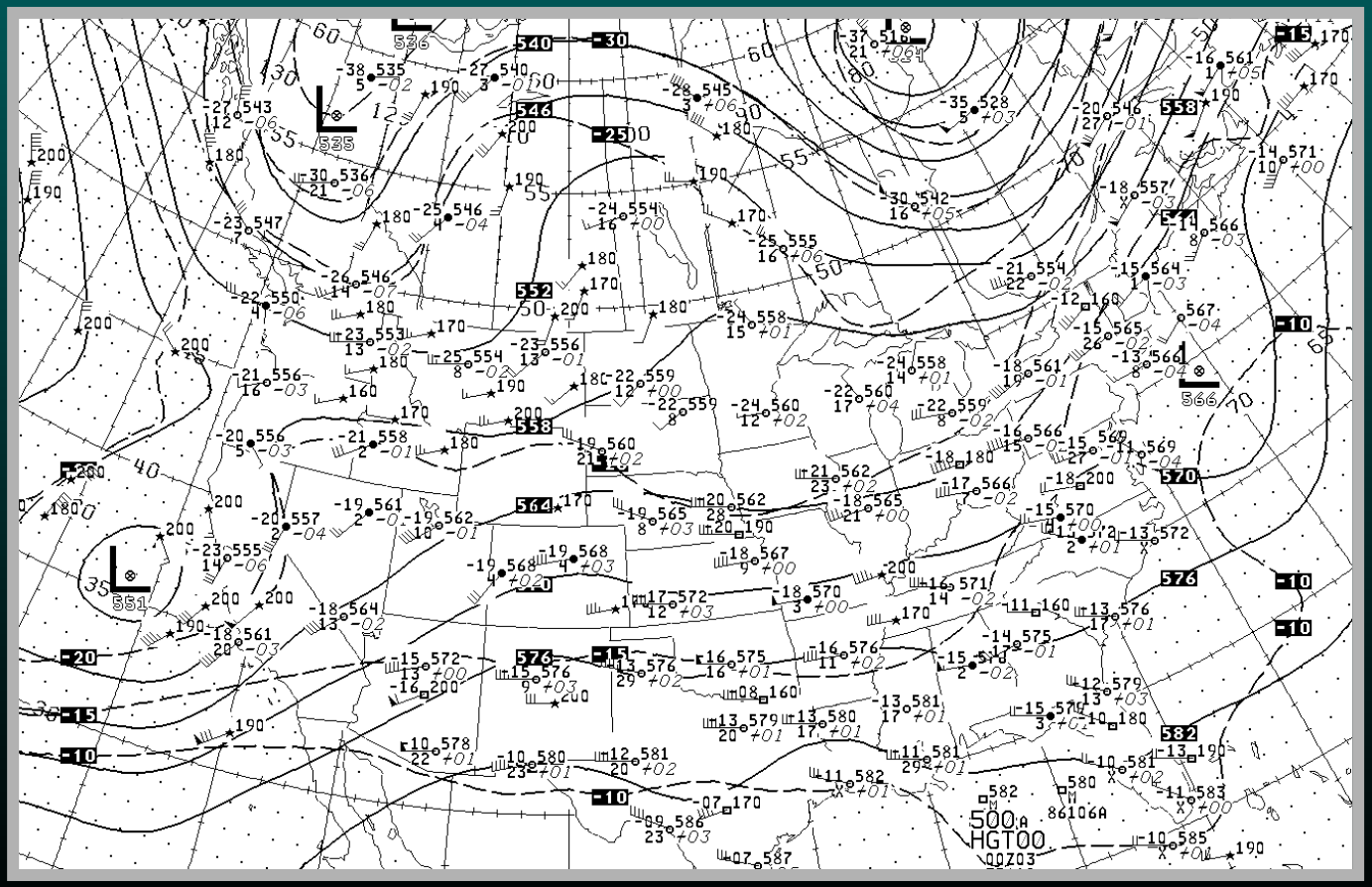
- General Atmospheric Circulation



Atmospheric Scales

Synoptic Scale:

- Size of 200 – 2000 km
- Time Scale is tens of hours to several days
- Frontal Systems, Tropical Cyclones (hurricanes & tropical storms)



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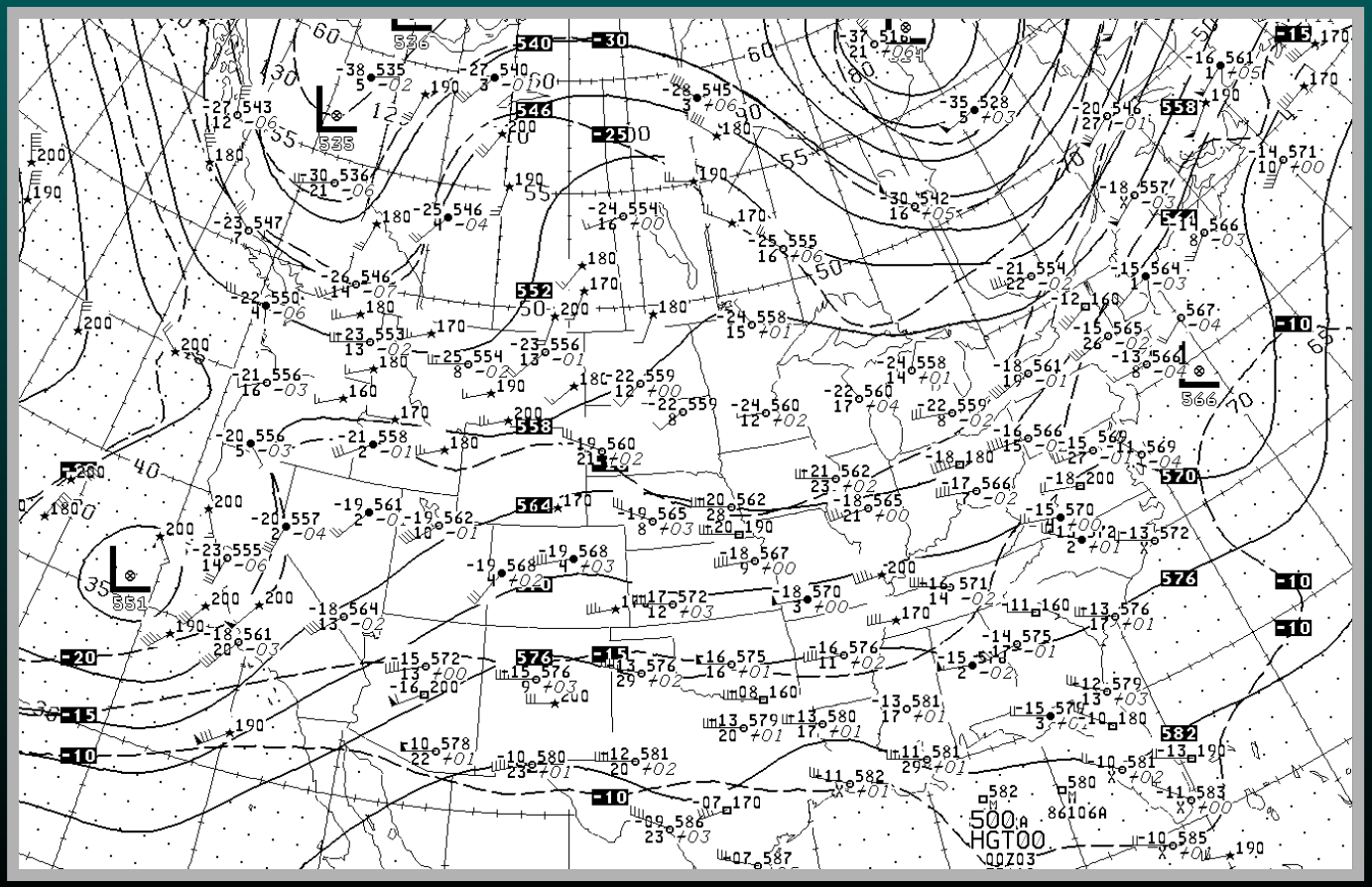
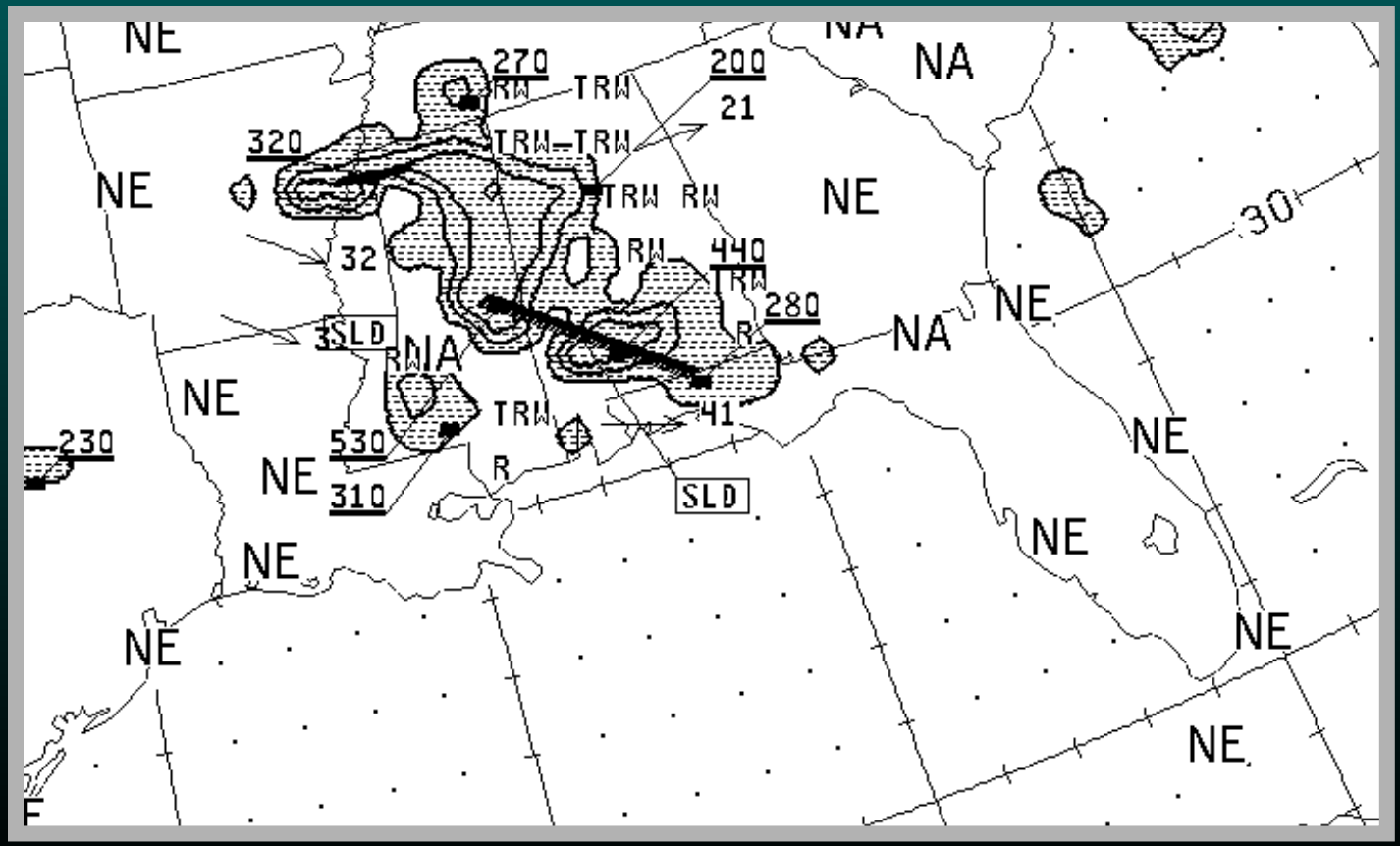


Atmospheric Scales

Mesoscale:

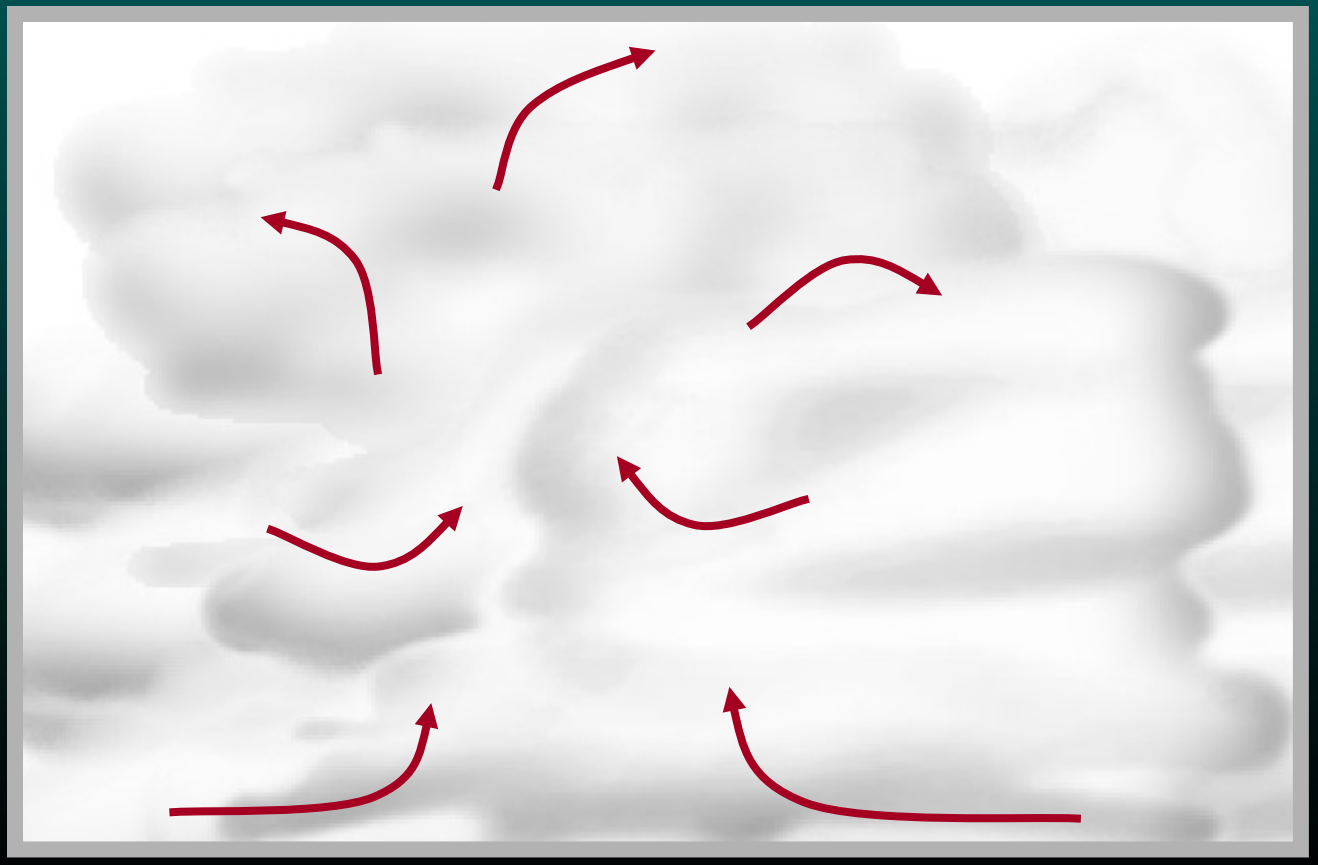
- Size of 1 to 500 nm.
- Time Scale is tens of minutes to several hours.
- Thunderstorms, Local Effects (land/sea & mountain/valley breezes)



Atmospheric Scales

Microscale:

- Size of less than 2 km.
- Time Scale is few seconds to few minutes.
- Turbulent Flow – Updrafts/Downdrafts.



Variable Relationships

Directly Proportional:

- When a change in one variable in the equation causes the same change In a another variable.

Ex. -

$$x = y$$

InDirectly (Inversely) Proportional:

- When a change in one variable in the equation causes the opposite chang In a another variable.

Ex. -

$$x = 1/ y$$

Variable Relationships

Determining the Relationship:

Rules of Engagement

- Only 2 variables can be compared at a time to determine the relationship to each other.
- Hold all others variables constant.
- Place a dot over the variables you are holding constant.
- Determine relationship by changing 1 variable and see what needs to happen to the other variable in order to maintain equality.

Example 1:

Determine relationship of x and z

$$x = y \cdot z$$

Example 2:

Determine relationship of x and z

$$x / z = y$$

Example 3:

Determine relationship of x and z

$$x \cdot z = y$$

Example 4:

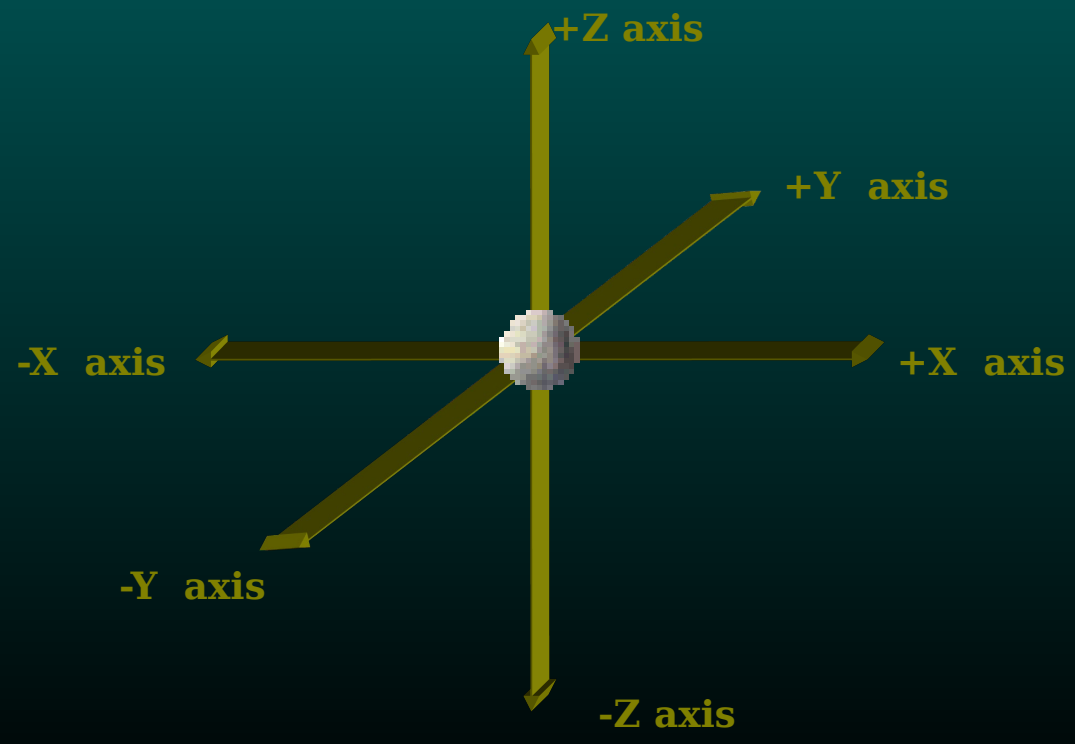
Determine relationship of x and z

$$x = y / z$$

Coordinate Systems

Cartesian Coordinates (x,y,z):

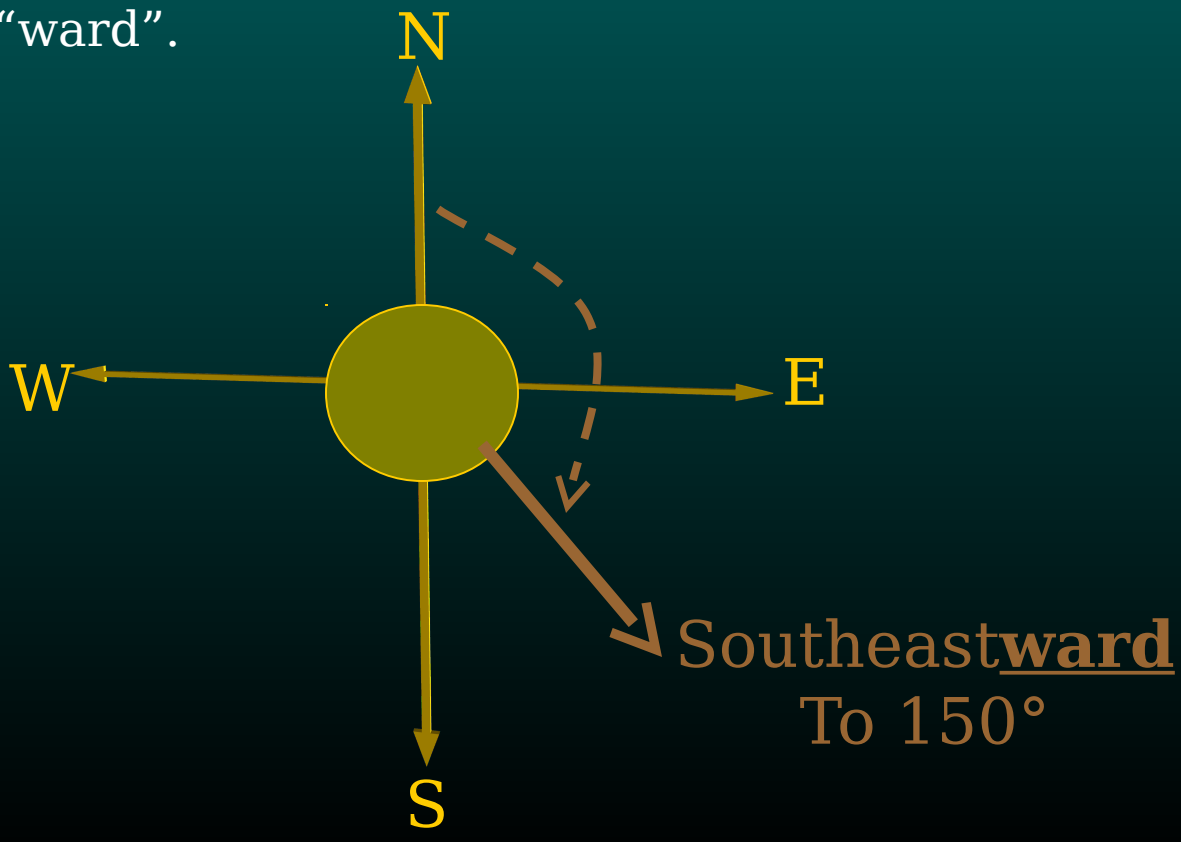
- 3 – Dimensional System.
- Basis for all other coordinate systems.
- 3 perpendicular axis that intersect 90° at the origin.



Coordinate Systems

Navigational System:

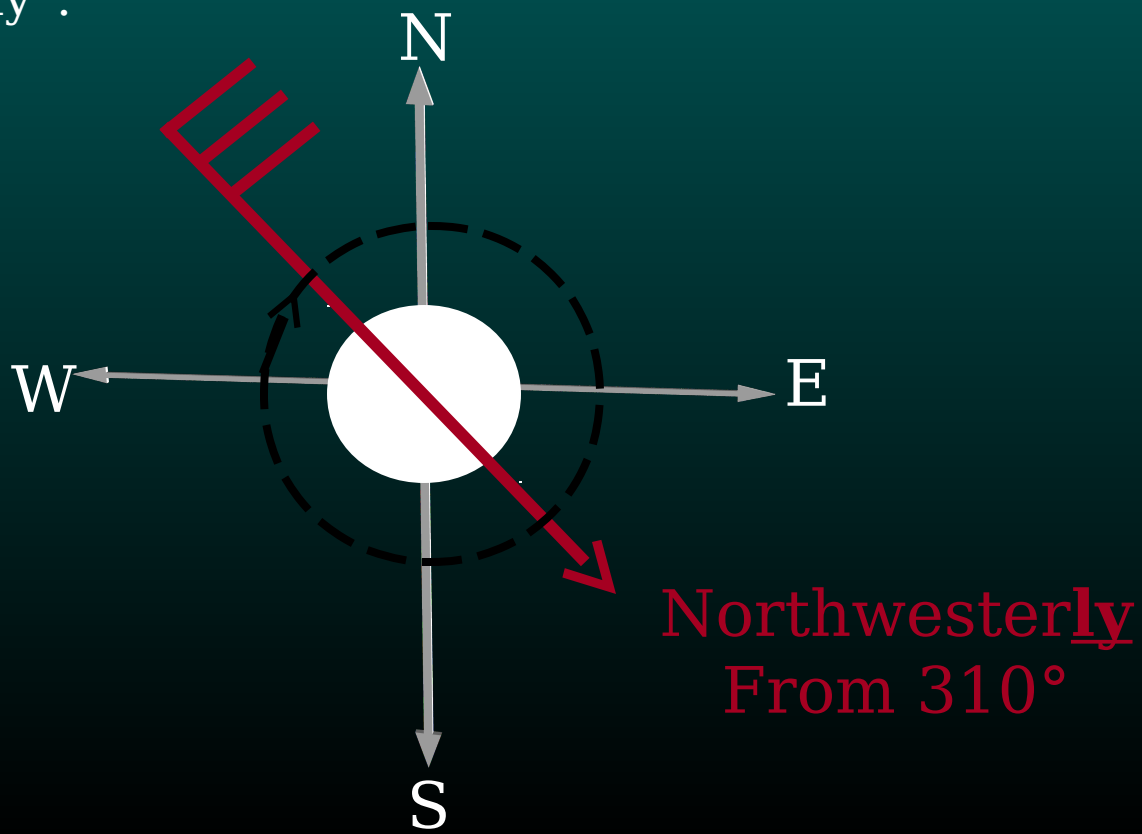
- 2 – Dimensional System.
- Describes motion towards which object is going.
- Magnitudes are indicated by length of arrows.
- Direction is indicated by orientation of the arrow (degrees clockwise).
- Suffixed by “ward”.



Coordinate Systems

Meteorological System:

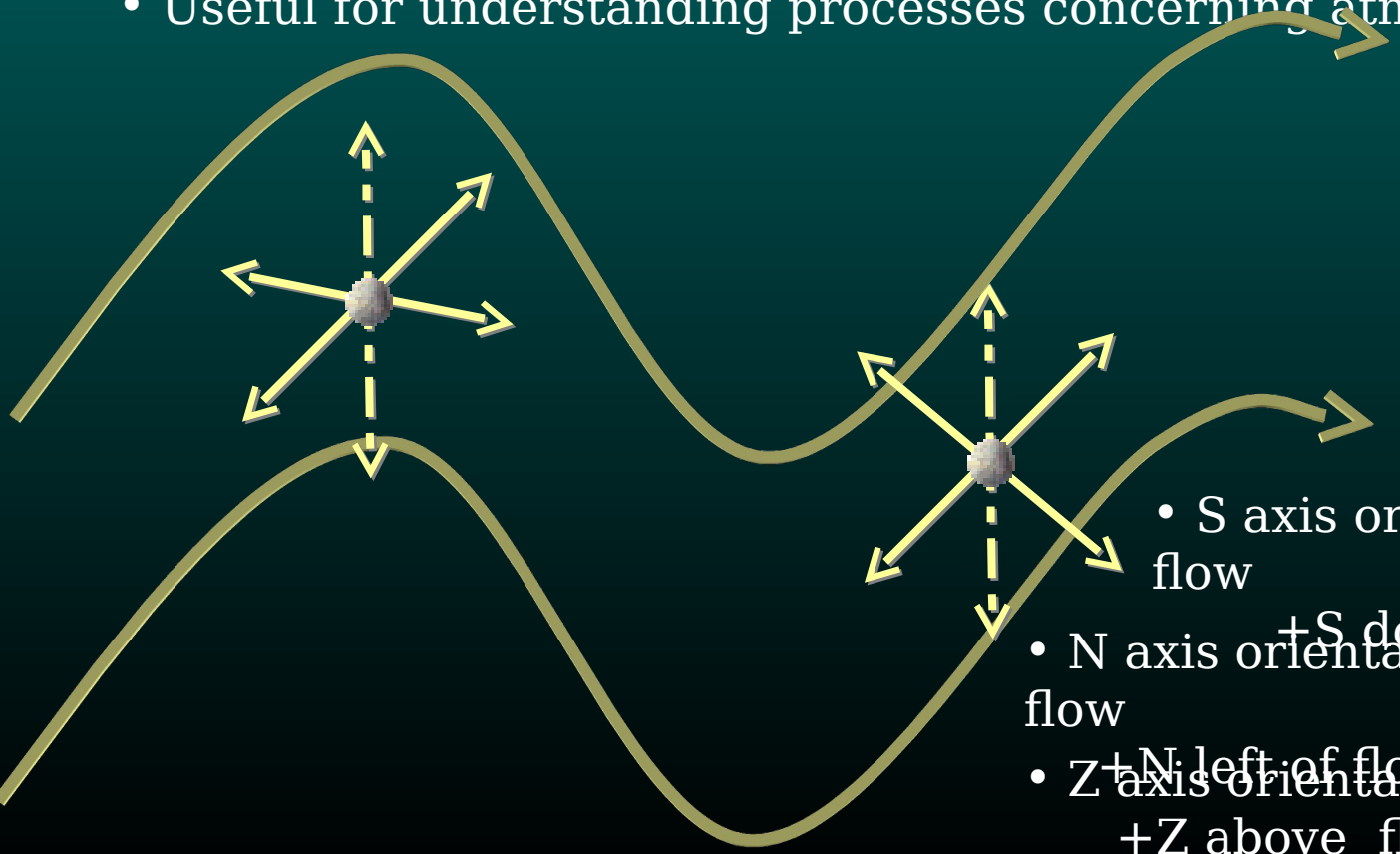
- 2 Dimensional System.
- Describes motion in the direction in which parcel is coming from.
- Magnitudes are indicated by barbs.
- Direction is indicated by orientation of shafts , clockwise from North.
- Suffixed by “ly”.



Coordinate Systems

Natural Coordinate System:

- 3 – Dimensional System.
- Describes motion in terms of direction towards which the object is movi
- 3 perpendicular axis that intersect 90° at the origin.
- Coordinate system moves with the wind flow.
- Useful for understanding processes concerning atmospheric motion.



- S axis orientated parallel to flow

  +S downstream / -S upstream
- N axis orientated perpendicular to flow

  +N left of flow / -N right of flow
- Z axis orientated vertically

  +Z above flow / -Z below flow

Atmospheric Fundamentals

Presentation made by GySgt K.L. Hubler